

Introduction

Selecting the right combination of blend tolerance, analytical tolerance and traceability is not a complex task. Airgas offers six grades, covering most specification requirements:

- EPA Protocol Gases
- Traceability Standards
- Primary Standards
- Precision Blends
- Certified Standards
- Batch Certified

The Mixture Specifications Table on the next page outlines these grades and their respective tolerances. If your requirements are different from those listed, simply call the Airgas Specialty Gas Technical Hotline (1-877-ASG-4-GAS) or your Airgas representative to fully review your needs. In addition, with the exception of the Batch Certified Mixtures, each calibration gas standard comes with a Certificate of Analysis at no extra charge. All mixtures are filled to 2000 psig at 70° F unless otherwise noted in the Technical Data sections.

Types of Grades Available

EPA Protocol Gases

EPA Protocol Gases are manufactured and analytically certified in strict accordance with the most recent EPA traceability guideline document entitled “EPA Traceability Protocol for Assay and Certification of Gaseous Standards”. The majority of EPA Protocol mixtures from Airgas are certified to a $\pm 1\%$ overall uncertainty guarantee, except where limited by the higher uncertainty of the NIST Standard Reference Materials (SRMs) or NIST Traceable Reference Materials (NTRMs). All analytical certifications are performed under completely interference-free conditions. Maximum allowable shelf life is guaranteed. Documentation fully conforms to the requirements of the EPA Protocol program, in compliance with the Clean Air Act.

Traceability Standards

Traceability Standards are calibration mixtures, which are analytically certified directly against either NIST SRMs or NTRMs, within a comprehensive quality system. The analytical testing process is based upon the EPA Protocol document, including triad analysis, comprehensive instrumentation characterization, and statistical data analysis. This results in a $\pm 1\%$ overall uncertainty (accuracy) with direct traceability to NIST Reference Materials, when supported by NIST.

Precision Blends

Precision Blends are developed to satisfy customer requirements for “zero blend tolerance” mixtures. These blends are manufactured by dynamically mixing the mixture components in real time while monitoring the composition using continuous analytical monitoring. Minor adjustments are made as needed during the blending process to assure the final mixture is statistically identical

to the requested composition, as verified through careful analysis.

This process has several advantages:

- Gas mixtures are provided at the requested concentration
- Homogenous composition of all cylinders within a batch
- Consistency of mixtures from one order to the next

Many Precision Blend mixtures are available upon request as Traceability Standards, i.e. with $\pm 1\%$ analytical traceability directly versus NIST Reference Materials.

Primary Standards

Primary Standards often referred to as NIST Traceable by Weight Mixtures, should be used when your application demands the highest mixture accuracy and reliability. Airgas produces Primary Standards gravimetrically on sophisticated high-load, high-sensitivity scales, with statistically measured precision and accuracy. These weighing systems are stringently calibrated with NIST traceable weights, in accordance with ISO procedures. Gravimetric blending offers the closest tolerance available, often better than available through laboratory testing. A dual verification of mixture accuracy is also performed by quality control analysis on instrumentation calibrated with Airgas Primary Standards, NIST SRMs, NTRMs, or GMIS.

Certified Standards

Certified Standards, sometimes referred to as working standards, are analyzed calibration mixtures used routinely in science and industry. For the majority of applications, the tolerance of a Certified Standard is acceptable. These standards are generally prepared either by partial pressure or gravimetrically. Certification of the standard is performed through quality control analysis on instrumentation calibrated with Airgas Primary Standards, NIST SRMs, NTRMs, or GMIS.

Batch Certified Mixtures

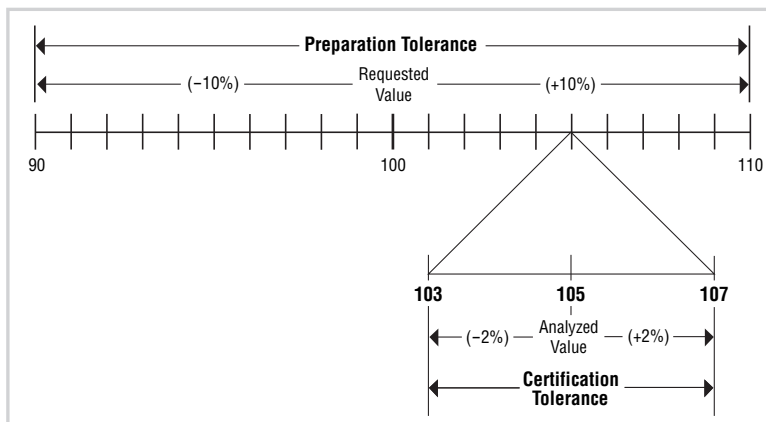
Prepared using the same techniques as Primary or Certified Standards. Composition is guaranteed to fall within the stated blend tolerance, with nominal concentrations reported.

Explanation of the Tolerances

Airgas has two tolerances associated with all our mixture grades. First is the Blend or Preparation tolerance. This is the minimum acceptable uncertainty associated with the actual production of the blend. These uncertainties are accumulated during the manufacturing process because of equipment used in production, and due to the physical properties of the gases. Second is the Analytical or Certification tolerance, which is the minimum acceptable uncertainty, associated with the analysis of the blend. This uncertainty is accumulated throughout the analytical procedure and includes instrument and calibration uncertainties.

For most applications, the analytical tolerance is of greater importance than the blend tolerance because it represents the range in which the true or actual concentration may be

Mix Grade	Concentration	Blend tolerances	Analytical tolerances All values are \pm relative	Note: Analytical tolerances for H ₂ S and NO ₂ EPA Protocol mixtures \pm 2% and Traceability Standard mixtures are \pm 1% for all concentrations.
EPA Protocol	< 2ppm 2ppm - 10ppm > 10ppm	Inquire \pm 1ppm \pm 5%	\leq 1% \leq 1% \leq 1%	
Traceability	< 2ppm 2ppm - 10ppm > 10ppm	Inquire \pm 1ppm \pm 5%	\leq 1% \leq 1% \leq 1%	
Primary	< 50ppm 50ppm - < 1% 1% - < 2% \geq 2%	Inquire 5% 1% 1%	Inquire \leq 1% \leq 1% \leq 0.02% absolute	
Precision Blend	All	"zero"	\pm 2%	
Certified	< 5ppm 5 ppm - < 50 ppm 50 ppm - < 1% \geq 1%	Inquire \pm 20% \pm 10% \pm 5%	Inquire \leq 5% \leq 2% \leq 2%	
Batch Certified				



All of Airgas' six mixture grades have two tolerances—preparation and certification. This graph shows how the two interrelate. For example, a certified mix ordered at 100 ppm is prepared between 90 ppm and 110 ppm (the preparation tolerance). Assume the mix, when made, reads 105 ppm. When analyzed in the lab, it may actually be between 103 ppm and 107 ppm (the analytical tolerance).

in relation to the analytical concentration. For some applications, such as those that require an upper or lower range of concentration that cannot be exceeded, the preparation tolerance becomes equally if not more important.

Traceability in Calibration Gas Mixtures

Airgas offers calibration gas mixtures with established and defined traceability to NIST or to an equivalent national measurement institute. Each traceable mixture is accompanied by full documentation in the form of a Certificate of Analysis (COA), designed in compliance with applicable guidelines.

Traceability is defined as “the property of the result of measurement or the value of a standard whereby it can be related to stated references, usually national or international standards, through an unbroken chain of comparisons all having stated uncertainties.” A requirement for ISO 9001 and ISO 17025 compliant programs, emissions monitoring and reportable environmental testing is that the instrument calibration process maintain traceability to a national primary reference material.

Calibration gas mixture compositional traceability is assured through one of two methods:

1) Analytical traceability using Reference Materials from a national measurement institute (usually NIST) to calibrate the measurement system through a rigorous process to determine the concentrations of mixture components of interest.

2) Process traceability to the international unit of mass (Kg) through comprehensive manufacturing and quality programs, using high precision, high sensitivity weighing systems for component additions. The resultant mixtures are analyzed versus Primary Standards of known composition and uncertainty.

Typically, the process-based traceability is used when Reference Materials are unavailable from NIST or other national measurement institutes for the component(s) or concentration(s) of interest. Blends produced gravimetrically, using scales extensively calibrated with NIST certified weights, are considered traceable and have known uncertainty in their composition.

The majority of traceable products supplied by Airgas are certified to an overall analytical or process uncertainty not to exceed \pm 1%.